Comparison of LMA CTrach and Video Laryngoscope in Endotracheal Intubation

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Abstract

Objective: In this study, our objective was to compare the Cormack and Lehane (C-L) sight scores of direct laryngoscopy in endotracheal intubation with the endoscopic sight scores of the LMA CTrach and video laryngoscope. We also compared the success of endoscopy with the LMA CTrach and video laryngoscopy, intubation time, and its effects on haemodynamic and stress responses.

Methods: The study included 100 patients, with American Society of Anesthesiologists (ASA) scores I-III and aged 18-65, who will undergo elective surgery. Patients were randomly divided into two groups: Group C and Group V. The patients in both groups underwent direct laryngoscopy with a Macintosh laryngoscope, and their C-L scores were recorded. In Group C, the patients were intubated with the LMA CTrach, and in Group V, the patients were intubated with a video laryngoscope. Patients' haemodynamic parameters, oxygen saturation, end-tidal carbondioxide, and endoscopic sight scores were recorded.

Results: The demographic characteristics and the ASA classifications of the groups were similar. When endoscopic sight scores were compared with C-L, better sight was obtained in the LMA CTrach group; no significant difference was detected in Group V. Regarding the success of the intubation, no significant difference was detected between groups. However, when intubation times were compared, there was a significant difference between groups. The intubation time was longer in Group C. There was no difference between groups in terms of the percentage changes of haemodynamic parameters, oxygen saturation, and end-tidal carbondioxide values of the patients.

Conclusion: In this study, when endoscopic sight scores were compared, better visualization was obtained in the LMA CTrach group. Therefore, in cases where intubation is difficult to apply in patients, the LMA CTrach can be an alternative application.

Key Words: LMA CTrach, video laryngoscope, endoscopic sight scores, endotracheal intubation

Introduction

Maintenance of a safe airway and providing adequate ventilation is one of the main tasks of the anaesthetist. The main condition for adequate ventilation is providing a safe airway. Endotracheal intubation is still the gold standard for airway management. Video-assisted techniques can be used to enhance the success of intubation if conventional techniques fail (1, 2).

Laryngeal mask airway (LMA) can be used instead of endotracheal tube (ETT) or facial mask during anaesthesia practice or to facilitate ventilation and ETT passage in patients with difficult airway. Recent advances in video technology and fiber optic systems have resulted in the development of new intubation devices and technologies such as video laryngoscopes and LMA CTrach (3, 4).

DCI Video Laryngoscope: Storz DCI video laryngoscope (*Karl Storz, Tuttlingen, Germany*) is a device that comprises a fiber optic camera attached to the light source of standard laryngoscopes in various sizes (Figure 1) (5, 6). DCI video laryngoscope provides visualization of laryngeal structures by the projection of video images that are reflected from the very distal aspect of laryngoscope blade onto a screen with a viewing angle of 80 degrees.

LMA CTrach: Is a modified version of LMA Fastrach with two built-in fiber optic channels attached to the tip of the airway tube. It has a detachable LCD screen that provides continuous video images during tracheal intubation (Figure 2) (7). Endotracheal tube can pass through LMA CTrach; it has an atraumatic tip and is designed to enter the trachea at the correct angle.

The present study aimed to compare Cormack Lehane (C-L) view scores obtained using direct laryngoscope (DL) during endotracheal intubation, with endoscopic appearance scores for LMA CTrach and video laryngoscope, as well as to compare LMA CTrach and video laryngoscope in terms of intubation success, time to intubation, and the effects on hemodynamic stress response.

Methods

The present study was carried out after obtaining approval of Ondokuz Mayıs University Faculty of Medicine 'Local Ethics Committee' (decision dated 30.06.2008 and numbered 2008/201). The patients enrolled in the study were first informed about the study and then their written and verbal consents were obtained.

A total of 100 ASA I-III patients aged between 18 and 65 years undergoing elective surgery, were enrolled in the study. Pregnant patients, patients with previous intraoral or neck surgery, and those with gastroesophageal reflux, delayed gastric emptying, severe respiratory disease and kyphoscoliosis were excluded. In the preoperative examination, age, gender, weight, anatomical structure of teeth, thyromental distance, distance from the mandibular condyle to the anterior point of the chin, mouth opening, neck movements and Mallampati scores were recorded.

The patients were randomly divided into two groups each containing 50 subjects: Group C consisted of those who underwent intubation by LMA CTrach and Group V consisted of those who underwent intubation by video laryngoscope.

Standard monitoring was performed by means of electrocardiography (ECG) in DII lead, non-invasive blood pressure (systolic arterial pressure, diastolic arterial pressure, mean arterial pressure), and peripheral oxygen saturation (SpO_2). In both groups, induction of anaesthesia was performed using 2-3 mg kg^{-1} propofol and 1 mcg kg^{-1} fentanyl, and 0.1 mg kg^{-1} vecuronium was administered for muscle relaxation.

Both groups underwent direct laryngoscopy by Macintosh laryngoscope, performed by an anaesthesia assistant, who completed four years of specialization training, and C-L scores were recorded; thereafter, the patients were ventilated for one more minute using a mask. Subsequently, airway intervention was performed by another anaesthesia assistant, who had completed four years of specialization training and had performed five successful intubations using LMA CTrach and video laryngoscopy.

In the patients in Group C, LMA CTrach was inserted into the oropharynx after its dorsal surface was covered with lubricating gel and connected to the anaesthesia circuit after its cuff was inflated. After ventilation was confirmed by inspection, auscultation and capnography, LMA CTrach monitor was placed on the connection point and endoscopic appearance scores were recorded (Figure 3). Attempts were made

to improve the endoscopic images by performing correction procedures by LMA CTrach on images with Grade II and higher, and then intubation was performed. The monitor was removed and LMA CTrach cuff was deflated after ventilation following intubation was confirmed by inspection, auscultation and capnography. The patient was weaned from mechanical ventilation; and the connector of the endotracheal tube was removed and LMA CTrach was removed from the endotracheal tube with the assistance of a tube changer. The connector was reattached and the patient was connected to the mechanical ventilator. In Group V, after endoscopic appearance scores were recorded during videolaryngoscopy, intubation was performed (Figure 4).

C-L scores that were obtained by direct laryngoscopy and endoscopic appearance scores that were obtained by Video laryngoscope and LMA CTrach were compared. In addition, time to intubation, number of attempts to achieve intubation, and changes in vital signs were also recorded for video laryngoscope and LMA CTrach groups.

Figure 1. Components of DCI video laryngoscope

Figure 2. LMA CTrach

Time to intubation was defined as the time between the insertion of the laryngoscope blade or LMA CTrach in patients' mouth to the detection of end tidal carbon dioxide (ETCO₂) on the monitor. Patients with three failed intubation attempts using LMA CTrach were intubated using Macintosh Laryngoscope.

Perioperative cardiovascular and haemodynamic responses including heart beat rate (HR), systolic arterial pressure (SAP), diastolic arterial pressure (DAP), mean arterial pressure (MAP), and peripheral oxygen saturation (SpO₂) were recorded before induction, after induction, just after intubation and at 1, 3, 5, 10, 20, 25 and 30 minutes of intubation. ETCO₂ concentration was recorded just after intubation and at 1, 3, 5, 10, 20, 25 and 30 minutes of intubation.

Figure 3. View of vocal cords by LMA CTrach

Figure 4. The video monitor view of DCI video laryngoscope during intubation

Statistical analysis

Statistical analyses were done using Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) for Windows version 15.0 package program. Data were presented as mean±standard deviation, median (minimum-maximum), frequency, and percentage. Analysis of data was done using Mann-Whitney U test, Wilcoxon test, student t-test, likelihood ratio test, and chi-square test. Level of significance was considered as $p < 0.05$.

Results

Demographic characteristics (age, gender, and body weight) and ASA grades were similar between the two groups ($p > 0.05$) (Table 1).

There was no significant difference between the groups in terms of patient characteristics such as anatomical structure of teeth, thyromental (TM) distance, distance between the mandibular condyle to the anterior point of the chin (MC), mouth opening, neck movements and Mallampati classes ($p > 0.05$) (Table 2).

Classification of the patients according to C-L scores and endoscopic appearance scores in the two study groups are presented in detail in Table 3 and the mean values for the groups are shown in Table 4. A better view of the vocal cords was obtained by LMA CTrach as compared to direct laryngoscopy ($p < 0.05$); however no significant difference was determined in Group V ($p > 0.05$).

In Group C, intubation was successful at the first attempt in 44 (88%) and at the second attempt in 3 (6%) cases, whereas intubation was unsuccessful even at the third attempt in 3 (6%) cases and thereby these cases were intubated using DL. In Group V, intubation was successful at the first attempt in 47 (94%) and at the second attempt in 3 (6%) cases. No significant difference was determined between the two groups in terms of intubation success rates ($p = 0.212$).

Time to intubation and end-tidal carbon dioxide concentration just after intubation are demonstrated in Table 5. Time to intubation was significantly longer in Group C than that of Group V ($p < 0.001$). There was no significant difference between the groups in terms of end-tidal carbon dioxide concentrations just after intubation ($p > 0.05$).

No difference was determined between the groups in terms of difference in percentage change of systolic arterial pressure, diastolic arterial pressure, mean arterial pressure, heart rate

Table 1. The demographic characteristics and ASA classification of the patients according to study groups*

	Age (years) (Mean±SD)	Gender (M/F) n (%)	Body weight (kg) (Mean±SD)	ASA I/II/III n (%)
Group C	46.9±13.6	24/26 (48/52)	76.9±14.2	23/25/2 (46/50/4)
Group V	43.5±14.0	21/29 (42/58)	75.1±16.0	32/18/0 (64/36/0)

* $p > 0.05$. ASA: American Society of Anaesthesiologists; SD: standard deviation; M: male; F: female

Table 2. Distribution of the groups according to the anatomical structure of teeth, TM distance, MC distance, mouth opening, neck movement and Mallampati classification*

	Group C (n=50) n (%)	Group V (n=50) n (%)
Teeth		
Normal	36 (72%)	41 (82%)
Protruded	2 (4%)	1 (2%)
Prosthesis	12 (24%)	8 (16%)
TM distance		
≥6 cm	49 (98%)	48 (96%)
<6 cm	1 (2%)	2 (4%)
MC distance		
≥9 cm	50 (100%)	47 (94%)
<9 cm	0 (0%)	3 (6%)
Mouth opening		
Normal	48 (96%)	50 (100%)
Restricted	2 (4%)	0 (0%)
Neck movement		
Normal	46 (92%)	49 (98%)
Restricted	4 (8%)	1 (2%)
Mallampati score		
I	34 (68%)	38 (76%)
II	16 (32%)	12 (24%)

*p>0.05. TM: thyromental distance; MC: distance between the mandibular condyle to the anterior point of the chin

Table 3. Classification of the groups according to Cormack-Lehane classification system and endoscopic appearance scores

	Group C n (%)	Group V n (%)
Cormack-Lehane classification		
I	20 (40)	33 (66)
II	28 (56)	14 (28)
III	2 (4)	3 (6)
IV	0 (0)	0 (0)
Endoscopic appearance		
I	38 (76)	34 (68)
II	9 (18)	13 (26)
III	0 (0)	2 (4)
IV	3 (6)	1 (2)

and oxygen saturation values before induction and just after intubation (p>0.05) (Table 6).

Discussion

Since the inclusion of laryngoscope in clinical practice, all interventions have focused on making the shape of the blade

Table 4. Comparison of Cormack-Lehane scores and endoscopic appearance scores between the groups (mean±standard deviation)

	Cormack-Lehane score	Endoscopic appearance score	p
Group C	1.6±0.5	1.3±0.7	0.017
Group V	1.4±0.6	1.4±0.7	0.782

Student t test was used

Table 5. Comparison of time to intubation and end-tidal carbon dioxide concentrations just after intubation between the groups, median (minimum-maximum)

	Group C	Group V	p
Time to intubation (sec)	84.0 (12-165)	36.5 (14-130)	<0.0001
End-tidal carbon dioxide concentration just after intubation	32.0 (20-41)	32.0 (22-38)	0.215

Mann-Whitney U test was used

Table 6. Comparison of percentage changes in haemodynamic parameters after intubation and just before induction between the study groups

	Group C (n=50)	Group V (n=50)	p
Systolic arterial pressure	-3.94±21.48	-5.36±26.01	0.945
Diastolic arterial pressure	5.70±18.30	4.12±22.21	0.917
Mean arterial pressure	0.86±18.57	0.20±24.65	0.899
Heart rate	3.83±14.48	2.84±14.11	0.908
Oxygen saturation	1.56±1.77	1.45±1.41	0.757

perfect. The aim of these interventions is to improve visualization of laryngeal structures and to increase the success rate of endotracheal intubation. Tracheal intubation may not always be successful despite these modifications even in patients, in whom intubation is not thought to be difficult. It is necessary to prepare alternative intubation equipment (LMA, LMA Fastrach, LMA CTrach, video laryngoscope, fiber optic laryngoscope, etc.) before induction in case anticipated difficult airway might be encountered or in patients who are expected to have difficult intubation based on physical examination.

Timmerman et al. (8) conducted a study using LMA CTrach in 60 patients; they first determined C-L scores by DL and then tried intubation using LMA CTrach. They achieved high success rates both in intubation and ventilation by LMA CTrach. They reported that tracheal intubation could be successfully performed even view scores are grade III or IV. Liu et al. (9) carried out a study in 100 patients that would undergo elective surgery and investigated the success rates of intubation with LMA CTrach. Ventilation was achieved in all 100 patients, but they reported that DL was better in obtaining

laryngeal view and intubation. They found the time to intubation to be 166 sec. (114-233) with LMA CTrach. Again, Liu et al. (10) were able to ventilate all of the patients after the insertion of LMA CTrach, but nevertheless, they could get a complete view of the glottis in only 31% of the patients. Although they obtained clear view in the majority of patients by correction manoeuvres, they failed in a few patients. They found that the mean time required for intubation was 118 seconds.

In the present study, ventilation was provided at the first attempt in all patients in the LMA CTrach group. Better endoscopic view was obtained by LMA CTrach as compared to direct laryngoscopy. Forty five percent of the patients were intubated at the first attempt. After aspiration and correction manoeuvres, clear view could be obtained in two of the remaining five patients and they were successfully intubated. However, since a clear view could not be provided, intubation was unsuccessful in the other three patients and they were intubated using DL. Median time to intubation by LMA CTrach was found to be 84 seconds.

Although time to intubation has been found long in the studies conducted using LMA CTrach, providing immediate ventilation appears to be an advantage. In addition, a good endoscopic image can be obtained in the great majority of patients after correction manoeuvres even though a good view could not be obtained in all patients at the first insertion.

Macnair et al. (11) compared video laryngoscope (VL) and direct laryngoscope in providing airway in the children aged 2-16 years. They found the mean time to intubation to be 12 sec. with DL and 22.5 sec. with VL. At first, C-L scores were assessed by DL in 30 patients and they were intubated using VL, while first endoscopic image was evaluated by VL and then intubation was performed by DL in the remaining 30 patients. In conclusion, they reported that VL provides a better glottic view than DL, although it prolongs the time to intubation. Van Zundert et al. (12) divided 450 patients that would undergo elective surgery into three groups each including 150 patients and compared three different types of VL (Glidescope Ranger, Storz V-Mac and McGrath series -5) in addition to the view by DL. They found that view scores were better with all VL types as compared to DL. The time to intubation was 34 ± 20 sec. with Glidescope Ranger, 18 ± 12 sec. with Storz V-Mac and 38 ± 23 sec. with McGrath series-5. Additionally, while a stylet had to be used in 7% of the patients in the Storz V-Mac group, stylet was required in 50% of the others. As is understood, time to intubation was shorter and intubation was easier with Storz V-Mac as compared to the others. Sixty four patients in the Glidescope Ranger group required stylet use for intubation and 49 of them were intubated at the first attempt and 15 were intubated at the second and third attempts. During intubation with Mc Grath series 5 VL, stylet was required in 88 patients and 65 of them were intubated at the first attempt, while 23

were intubated at the second attempt. Stylet was required to be used in 10 patients that were intubated using Storz V-Mac video laryngoscope and eight of them were intubated at the first attempt and two of them were intubated at the second attempt. In conclusion, it was stated that VL provides good conditions and good glottic view for intubation, but this might not ensure easy and successful insertion of the tracheal tube. Vlaten et al. (13) used standard direct laryngoscopy and STORZ video laryngoscopy in 56 children aged 4 years and below. Whilst the mean time to best view was 5.5 sec. with DL and 7 sec. with VL, time to intubation was 21 sec. with DL and 27 sec. with VL and the percentage of glottic opening was 97.5% with DL and 100% with VL. It was observed that Storz VL provided improved glottic view in children but, nevertheless, required longer time for intubation.

Hassan et al. (14) reported that pressure exerted on the base of the tongue by the blade during direct laryngoscopy leads to arterial hypertension, tachycardia and increase in catecholamine levels by means of proprioceptive stimuli. They reported that tracheal intubation augments haemodynamic response and epinephrine response by stimulating tracheal and laryngeal receptors. In another study (15), patients were divided into two groups; in the first group, laryngoscopy was performed for 10 seconds and then the patients were ventilated via a mask, in the second group, again laryngoscopy was performed for 10 seconds then the patients underwent intubation. They reported no significant difference between the two groups before and after induction in terms of adrenalin and noradrenalin levels, arterial tension and heart rate. They reported that tissue irritation in the supraglottic region that was stimulated by direct laryngoscope is the major reason for sympathoadrenal response to tracheal intubation. In the present study, direct laryngoscopy was performed in both groups and then intubation was performed by LMA CTrach or video laryngoscope. Percentage changes in haemodynamic parameters being similar before and just after intubation suggests that similar stimuli occurred in the supraglottic region, larynx and trachea both with LMA CTrach and video-laryngoscopy. However, the effects of these two methods on haemodynamic response could not be compared with that of direct laryngoscopy because of the design of our study.

In the present study performed with VL, we used 'Storz V-Mac' video laryngoscope. Glottic views obtained by DL and VL were not superior to each other. During intubation, cricoid pressure was applied in four patients, stylet was not used in any of the patients, and 100% intubation success was obtained. Median time to intubation was found to be 36.5 seconds.

When compared with LMA CTrach, it is seen that VL can be more commonly and easily used in daily practice due to shorter time to intubation, high intubation success, and absence of difference with DL in terms of view scores. LMA CTrach can be primarily preferred to VL because of the ad-

vantages such as rapid ventilation, similar end-tidal CO₂ levels with VL after intubation, and better endoscopic appearance score in patients, expected to have difficult intubation.

Conclusion

According to the results of the present study, we concluded that videolaryngoscope can be easily used in daily practice and that practical use of LMA CTrach is more difficult. However, we think that LMA CTrach can also be used as an alternative method in patients expected have difficult intubation since better view was obtained in the LMA CTrach group when endoscopic appearance scores were compared.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Ondokuz Mayıs University School of Medicine (30.06.2008, protocol no: 2008/201).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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